INTEGRATED, COMPREHENSIVE ECOLOGICAL IMPACT ASSESSMENTS IN SUPPORT OF DEPARTMENT OF ENERGY DECISION MAKING

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EXECUTIVE SUMMARY

With the increased awareness of and interest in potential ecological risks or impacts associated with past, current, and future Department of Energy (DOE) activities, DOE's Defense Programs Office of Technical and Environmental Support sponsored this study to (1) evaluate the effectiveness of the current compliance-driven environmental protection and assessment efforts relative to ecological concerns; (2) explore the need for an integrated approach for assessing ecological risks or impacts; and (3) identify the requirements for such an approach.

Evaluations of the effectiveness and efficiency of compliance-driven activities at DOE facilities with respect to protection and assessment of impacts to ecological resources were based on an extensive review of DOE orders and regulations and other federal regulations and in-depth interviews with individuals at selected DOE facilities responsible for implementing these regulations and orders. Interviews also were conducted with industry environmental managers to learn about industry issues and approaches to provide a basis for comparison with those of DOE and to glean useful information for DOE environmental managers. This report includes the results of the document review and interviews and a discussion of the study conclusions based on these results.

A major conclusion of the study is that high-level, process-oriented guidance is needed to direct the development of an integrated, comprehensive approach to ecological impact assessments and ecological management at DOE facilities. The goals of this approach should be to improve decision making, reduce redundancies, enhance consistency in ecological assessment and protection activities, and provide the means for a comprehensible evaluation of the potential impacts of a proposed project.

Integration should be across multiple DOE environmental protection activities. For example, an integrated approach should support DOE decision making driven by the National Environmental Policy Act (NEPA); the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); the Natural Resource Damage Assessment (NRDA) requirements, the Resource Conservation and Recovery Act (RCRA); DOE monitoring and surveillance orders; and DOE integrated safety management requirements while also serving DOE land-use planning and management requirements. A comprehensive approach, while supporting project, media, and species-specific concerns, should address ecological impacts on spatial and temporal scales that make sense in terms of protecting valued ecological resources.

Identified requirements for an integrated, comprehensive approach include (1) a site-specific ecological management policy statement, (2) specific measurable management goals derived explicitly from the policy statement, (3) performance measures for the management goals tied to management actions, and (4) data collection guidance based on evaluation of the performance measures and on the data requirements to assess the impacts of proposed projects. In addition, a well-maintained, accessible, Geographic Information System-linked data base and a well-defined conceptual model are essential tools for implementing a comprehensive, integrated approach. This report also describes lessons learned from an ongoing effort at a DOE facility to streamline data collection activities by developing an integrated, comprehensive approach for ecological assessments following the requirements specified in this study.

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1.0. INTRODUCTION

With the increased awareness of and interest in potential ecological risks associated with past, current, and future Department of Energy (DOE) activities, DOE's Defense Programs (DP) Office of Technical and Environmental Support sponsored this study (1) to evaluate the effectiveness of the current compliance-driven environmental protection and assessment efforts relative to ecological concerns; (2) to explore the need for a more focused, integrated approach to address ecological impacts; and (3) to identify the requirements for an integrated approach if such an approach was deemed necessary. This report presents the results of this study and describes lessons learned from early attempts at a DOE facility to streamline data collection activities by developing an integrated approach for ecological assessments following the requirements identified in this study.

2.0. OBJECTIVES

The study explored four questions.

- Which federal regulations and DOE orders either explicitly require ecological assessments or implicitly require them through environmental protection language?
- What currently is being done at selected DOE facilities to implement these regulations and orders?
- What are private sector industries doing in terms of ecological risk assessments and how do industry approaches and issues compare with those of DOE?
- What, if anything, in addition to current efforts is needed to ensure the protection of ecological resources associated with DOE facilities, to support defensible decision making, and to improve efficiency?

The following questions are examples of DOE decisions that require ecological impact analysis.

- Are legacy wastes from past DOE activities adversely impacting ecological resources?
- What ecological resources are at risk from operations associated with new facilities and projects or major modifications to existing facilities and projects?
- What ecological resources should be included in a cumulative impacts study of past, present, and future actions for a National Environmental Protection Act (NEPA) environmental assessment (EA) or environmental impact statement (EIS)? What are the cumulative impacts on these resources?
- Will potential accidents associated with new facilities and major projects, or significant modifications to existing facilities and major projects, present an unacceptable environmental risk in terms of ecological impacts?
- How should impacts to ecological resources be included in DOE decisions about new uses of DOE lands as the DOE's defense mission requirements change?

3.0. APPROACH

We reviewed all relevant environmental protection regulations and current and pending DOE orders to understand existing requirements for ecological data collection and impact assessments. To determine how these requirements are actually being carried out, we interviewed environmental managers responsible for their implementation at three DOE facilities—a small, a medium, and a large site (the size is based on the extent of ecological resources). To compare DOE issues and approaches with those of private industry, we interviewed environmental managers for several large companies. These companies were nation-wide; had multiple facilities; and were selected from the petroleum, mining, rubber, aerospace, brewing, and computer manufacturing industries.

4.0. DOCUMENT REVIEWS

The document reviews focused on five areas.

1. Stated purpose of the regulation or order

2. Intent of the regulation or order with respect to environmental protection, for example:

- How is environment defined?
- Are ecological resources implicitly or explicitly included in the definition of environment?
- What (if any) ecological resources are targeted?
- What language is used to describe environmental protection or the evaluation of environmental risks or impacts?
- What are the requirements for environmental protection?
- What guidance, if any, is given for including environmental and/or ecological concerns in the decision-making process?
- Is the order, regulation, or guidance clear or confused on the issue of what is meant by environmental protection and how environmental concerns will affect the decision-making process?

3. The minimal compliance requirements, for example, identification of required reports and/or monitoring activities

4. Identification of the decisions explicitly or implicitly required by the regulation or order relative to environmental protection, particularly protection of ecological resources

5. Identification of decision makers and the role of the public in decision making

The discussion in the following subsections summarizes the results of the document review. Detailed discussions of areas 1–5 are given in the companion document "Review of Orders and Regulations Requiring Environmental Protection" (Kelly et al., 1996).

4.1. Department of Energy Orders

Compliance/Monitoring Orders and Regulations. Numerous DOE orders require compliance with federal regulations and specify surveillance and monitoring activities to ensure compliance. For example, Orders 4300.1C, 4320.1B, 5100.3, 5100.4, 5100.5, and 6430.1A require collection and evaluation of endangered species data; compliance with the Endangered Species Act; identification and mapping of locations of endangered species; and avoidance of endangered species' critical habitat during activities covered by these orders. Order 5400.1 requires environmental surveillance to verify compliance with applicable environmental laws and regulations. DOE Order 5400.5 and draft regulation 10 CFR 834 require biota monitoring and assessment of impacts from radiological releases to biota. Draft regulation 10 CFR 834 actually requires a dose assessment to biota. DOE's responsibilities with respect to compliance with Floodplain and Wetland Executive Orders (11988 and 11990) are codified in 10 CFR Part 1022.

Safety Orders and Standards, Occurrence Reporting, Facility Design and Operations. Numerous safety orders and standards call for protection of the environment. However, what is meant by "protection of the environment" is not clear. In older orders, accident consequence analyses were limited to evaluation of releases to air, water, and soil and risks to human health. It appears that risk assessments were limited to human health effects because (1) it was assumed that protecting the abiotic components of the environment and human health resulted in protection of ecological resources and (2) methodologies for evaluating ecological risks were not well developed. The assumption that protecting human health was protective of ecological resources has been documented for radiological effects (IAEA 1992), and radiological effects were the main focus of safety concerns in the past.

In the newer orders and guidance (for example, Order 5480.23 and its guidance document, Standard 3009), there is clearly a mandate to assess impacts from the accidental release to the environment of chemical as well as radiological constituents. In Order 5480.23, the separation of human health and safety concerns from those of environmental protection is emphasized. However, what is required in the way of assessing impacts to the environment is not at all clear. The Order does emphasize the need to coordinate safety analyses with previous environmental investigations such as NEPA environmental impact statements.

The supporting guidance document (Standard 3009) retreats from an assessment of environmental impacts and environmental protection in safety analyses by noting "Safety structures, systems, and component (SSC) designations are not required for issues solely related to environmental protection. In accordance with DOE Order 5480.22, Technical Safety Requirements (TSR) designations are not required for such issues either. TSR designation associated with prevention of uncontrolled release of hazardous materials would typically be assigned for defense-in-depth considerations." Although not stated explicitly in the Standard, the underlying assumptions appear

to be that (1) defining safety SSCs and developing TSRs based on public exposure limits, worker safety considerations, and defense in depth and (2) meeting EPA environmental regulations demonstrates adequate protection of the environment as required by DOE Order 5480.23

Occurrence Reporting Requirements (Order 5000.3B), General Design Criteria (Order 6430.1A), and Conduct of Operations (Order 5480.19) require general environmental protection. However, what this means in terms of protecting ecological resources is not specified.

Despite the absence of clear direction as to what is meant by environmental protection and how it is to be assessed and evaluated, DOE is clearly including protection of the environment in the definition of safety. This is seen not only in Order 5480.23, but also in DOE's proposed implementation plan for Defense Nuclear Facility Safety Board (DNFSB) Recommendation 95-2 (DOE 1996). In this document, "safety is used synonymously with environment, safety, and health (ES&H) to encompass protection of the public, the workers, and the environment."

The implementation plan for DNFSB Recommendation 95-2 recommends an integrated management framework to ensure safety. The safety management system described in this document has components similar to those found in the ISO 14001 environmental management system (EMS) (Hemenway 1995), including setting safety goals, establishing clear roles and responsibilities, and ensuring that overall management of safety functions becomes an integral part of the Department's business process. Other goals include establishing "analytical bases for setting risk-based management and project priorities" and recognizing "that many existing programs and initiatives related to safety management must be reconciled and brought into a coherent, appropriate, integrated system."

National Environmental Protection Act (NEPA). DOE Order 451 (replacing Order 5440.1E) and 10 CFR 1021 establish procedures that DOE must follow to comply with Section 102(2) of the NEPA (42 U.S.C. 4332(2)) and the Council on Environmental Quality (CEQ) implementation procedure provisions (40 CFR parts 1500–1508).

The ultimate goal of the NEPA process is to help public officials make decisions that are based on an understanding of the environmental consequences of those decisions and to take actions that protect, restore, and enhance the environment. The CEQ provisions state that federal agencies shall, to the fullest extent possible, interpret and administer the policies, regulations, and public laws in accordance with the policies set forth in the act; implement procedures to make the NEPA process more useful to the public and decision makers; integrate the NEPA process in planning and review; and use the NEPA process to identify and assess reasonable alternatives that will avoid or minimize adverse effects upon the quality of the human environment.

Human environment is to be "interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment." Natural systems include air, water, and ecosystems (as noted in the definition of indirect effects in 40 CFR 1508.8).

The DOE orders and regulations make it clear that it is DOE's policy to follow the letter and spirit of NEPA, comply fully with the CEQ regulations, and apply the NEPA review process early in the planning stages for DOE projects.

DOE Order 451 establishes the requirements and responsibilities necessary to ensure efficient and effective implementation of DOE's NEPA responsibilities and emphasizes teamwork. A key responsibility for all participants is to control the cost and time for the NEPA process while maintaining its quality. The order is largely administrative and does not specifically identify ecological resources or address technical implementation requirements. The order does mention the incorporation of NEPA values, such as analysis of cumulative, off-site, ecological, and socioeconomic impacts, to the extent practicable, in DOE documents prepared under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA).

NEPA requires the evaluation of cumulative impacts or effects. Cumulative impact is defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7).

Facility Planning and Land Use. The Secretary of Energy has issued a land- and facility-use policy for the DOE (O'Leary, 1994) that makes the following statement.

> "It is Department of Energy policy to manage all of its land and facilities as valuable national resources. Our stewardship will be based on the principles of ecosystem management and sustainable development. We will integrate mission, economic, ecological, social, and cultural factors in a comprehensive plan for each site that will guide land and facility use decisions. Each comprehensive plan will consider the site's larger regional context and be developed with stakeholder participation. This policy will result in land and facility uses which support the Department's critical missions, stimulate the economy, and protect the environment."

Although never finalized, draft Order 4310 defines ecosystem management as "the integration of ecological principles and economic and social factors to manage ecosystems to safeguard ecological sustainability, biodiversity, and productivity. It is a proactive, goal-driven approach to sustaining ecosystems and their values. It needs a cooperatively defined vision of desired future ecosystem conditions that integrate ecological, economic, and social factors affecting a management unit defined by ecological, not political, boundaries."

Even though not as explicit as draft Order 4310 in terms of ecological management requirements, DOE Order 430.1, Life Cycle Asset Management, calls for managing DOE assets as "valuable national resources" and calls for asset management performance measures. These performance measures are to include a comprehensive land-use planning process with stakeholder involvement.

4.2. Federal Regulations

The Clean Air Act (CAA) is generally not a driver for ecological data collection. Air monitoring data are used to determine compliance with various standards and to comply with state implementation plans. EPA's 1990 Clean Air Act Amendments do require the assessment of residual risks after technology-based controls are implemented. However, if and how ecological risk assessments will be required for residual risk assessments is not clear at this time (Commission on Risk Assessment and Risk Management 1996).

The Clean Water Act (CWA) requires sites to comply with minimum effluent standards or discharge permit requirements. These standards are presumably protective of ecosystems. The standards are set by the regulators (EPA or state) and can be based on best available technology or water quality. If they are based on the latter, a determination must be made about the intended use of the waters into which the discharge is entering. One such use is protection and propagation of fish and other aquatic life. When a permit is being developed for a new source or when permits are being negotiated for existing National Pollutant Discharge Elimination System discharges, information must be supplied by a site to assist in the review of the permit application. After a permit is in place, the CWA has extensive monitoring requirements. Data to evaluate the impact of the discharge on biota, demonstrate compliance with the applicable standards, and measure toxic substances in the discharge are required. This information can be very helpful in evaluating the overall ecological impact of point sources at a site.

EPA published the "Proposed Guidelines for Ecological Risk Assessment" in the Federal Register on September 9, 1996 (61 FR 47552) for a 90 day public review and comment period. The Proposed Guidelines are being developed by the Office of Research and Development (ORD) to improve the quality of and consistency among EPA's ecological risk assessments. The Proposed Guidelines expand upon the widely-used EPA report "Framework for Ecological Risk Assessment," however, the proposed guidelines are still quite general and do not provide detailed implementation guidance. EPA intends to prepare more detailed guidance in specific areas in the future. Ecological risk assessment, as described in the proposed guidance, is a process for organizing and analyzing data, information, assumptions, and uncertainties to evaluate the likelihood that one or more stressors are causing or will cause adverse ecological effects.

The proposed amendment to the Resource Conservation and Recovery Act (RCRA), referred to as the Hazardous Waste Identification Rule (HWIR), uses ecological risk assessment (as well as human health risk assessment) to establish exit criteria for hazardous constituents in wastes below which listed hazardous wastes would be reclassified and would become delisted wastes under RCRA. The approach taken for developing terrestrial ecological exit criteria is based on ecological risk assessment (consistent with the Proposed Guidelines for Ecological Risk Assessment) for a generic terrestrial ecosystem and population-level effects for birds and mammals. The aquatic exit criteria are based on ambient water quality criteria (where data are adequate) or the Great Lakes Initiative Tier II approach (where data are not adequate) (EPA 1995). The main problem with developing ecological exit criteria is the lack of adequate toxicological data for the majority of chemicals considered.

CERCLA, also called the Superfund Program, requires ecological risk assessments, and as a result has been one of the dominant drivers for ecological risk assessments at DOE facilities. Under the Superfund Program, ecological risk assessments are to be conducted as part of the baseline risk assessments to support the decision of whether remedial action is needed and, in the event that remediation is needed, to support the selection of a remedial alternative. Environmental evaluations conducted under Superfund must be performed to assess threats to ecological resources with a special emphasis on sensitive and critical habitats for species protected under the Endangered Species Act. The Superfund Program is the first EPA program to issue ecological risk assessment guidance. In 1989 the Superfund Program issued conceptual guidance for planning studies to evaluate a site's environmental resources (largely synonymous with ecological resources) in the "Risk Assessment Guidance for Superfund. Volume 2: Environmental Evaluation Manual." Additional information on specific topics in ecological risk assessment was published in the ECO Update Series in 1991 and 1992. However, these documents did not provide adequate guidance for designing and implementing a step-by-step process for ecological risk assessments. In 1994, the Superfund Program tried to remedy this deficiency by issuing draft guidance, "Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments." This guidance was based on the EPA's agency-wide "Framework for Ecological Risk Assessment", but provided more detailed guidance for Superfund applications. In August (1996), a new version of this draft Superfund guidance was released for external review.

Natural Resource Damage Assessment (NRDA) involves both proactive and reactive types of decisions. In a proactive sense, if natural resource injuries are expected to result from the implementation of a proposed remedial alternative, then an evaluation of whether to proceed with remediation, and if so, which alternative to select, should be made. If a project may affect natural resources, then the project should be evaluated to determine how to reduce natural resource impacts and liability. If a CERCLA hazardous substance has been released, then that release should be evaluated with respect to natural resource injury and liability. Assessing potential or actual ecological injury is an important component of NRDA.

RCRA corrective action regulations do not explicitly require consideration of ecological impacts; however, as currently implemented across DOE, most sites have incorporated the CERCLA requirements to conduct an ecological risk assessment as part of the RCRA corrective action process. This approach may prevent the need to reevaluate sites with respect to ecological impacts that currently are being cleaned up under RCRA. Ecological risk assessments also address RCRA general requirements to be protective of human health and the environment.

The Migratory Bird Act requires sites to determine if nests, fledglings, or eggs are present within the impacted footprint of a proposed project. If so, the site either has to get a permit from the U.S. Fish and Wildlife Service to remove the nest or delay the project.

The Threatened and Endangered (T&E) Species Act requires a number of different kinds of decisions to be made:

- whether to designate an area as a critical habitat;
- whether to exclude an area from critical habitat designation, and
- whether to add or remove a species from either of the lists published under Subsection C of the Act.

In addition, a number of site-specific decisions are required. These include:

- whether to issue a permit for a proposed project that may impact a T&E species or habitat, and
- whether to conduct a Section 7 negotiation for a proposed action that may impact off-site T&E species.

To support these decisions, data on the presence/absence, location, and abundance of T&E species and associated habitats are required. In addition, information on the expected footprint associated with any proposed project is required.

Wetlands protection regulations establish a number of requirements that must be complied with to prevent loss of wetlands from any site activities. The Act requires site managers to determine if wetlands may be affected by a proposed project. If so, a determination is made as to how to avoid, minimize, or mitigate impacts with alternatives to the proposed action. Sites must maintain knowledge of the presence and location of wetlands in areas potentially impacted by site activities, as well as the location and timing of proposed projects.

5.0. INTERVIEWS

5.1. Interviews with Department of Energy Environmental Managers

Interviews with environmental managers were conducted at three DOE facilities. For the purposes of this report, these facilities are classified as small, medium, and large according to the extent of their ecological resources. Twenty environmental and safety mangers were interviewed at the large facility. Almost all of the interviews were conducted with individual managers. This section summarizes the results of the interviews and describes those issues relevant to ecological concerns. The interviews invariably raised broader environmental management issues. These broader issues are described in the more detailed discussion of the interview results found in Appendix A.

At the medium site, interviews were conducted informally with individual managers and groups consisting of managers and staff over several months. Only one interview was conducted at the small site; the interview was with a group consisting of one environmental manager and two staff members. However, this group was responsible for all ecological monitoring and assessment outside of the environmental restoration program. The main goal of the interviews at the medium and small sites was to understand the similarities and differences between these facilities and the large facility. Differences and similarities between the three sites are identified in the summary that follows.

The DOE interviews explored five questions.

- What compliance activities related to DOE orders and federal regulations address ecological assessments? Do these meet the intent of the associated orders or regulations with respect to the protection of ecological resources? If they do not, what is needed to remedy this problem?
- What are the key decisions associated with the orders and regulations?
- Can compliance activities be better integrated to provide a more cost-effective approach for protecting ecological resources and supporting the relevant DOE decisions?
- If integration of compliance activities is appropriate, what are the requirements for an integrating approach?
- What are the impediments to integrating activities (organizational structures, sources of funding, lack of accepted methodology, etc.)?

In general, three different approaches were used to assess ecological impacts: monitoring, expert judgment, and ecological risk assessment. The most common approach was a combination of monitoring and expert judgment. Expert judgment often was used to determine if a current activity, proposed project, or accidental release of contaminants to the environment presented a significant ecological impact. Only the medium site had fully developed and implemented an ecological risk assessment approach based on EPA guidance (EPA 1992) to support CERCLA/RCRA remediation decisions.

DOE Orders 5400.1 and 5400.5 require biota monitoring; however, they provide no guidance on what biota to monitor. At the large site, a recent DOE audit indicated that more biota data should be collected, but it did not indicate what biota data were needed. In addition, at both the large and small site, funding for biota data collection traditionally has come from individual projects and has not been based on a well-specified ecological assessment framework or biological monitoring plan. This lack of a comprehensive framework to guide biota monitoring has resulted in biota data collection that frequently does not meet the needs of NEPA (particularly for site-wide environmental impact assessments) or environmental restoration risk assessments.

Many environmental managers could not identify the decisions that their monitoring or other environmental assessment activities supported. Many programs were viewed as simply compliance or surveillance programs not linked to decision making.

At the large facility, environmental managers responsible for implementation of the CAA, the CWA, and the DOE safety orders felt that, in terms of their responsibilities and activities, ecological resources were protected adequately. However, those interviewees responsible for safety analysis reports (SARs) felt that there was confusion about whether potential ecological impacts are to be addressed explicitly in the SARs. DOE Order 5480.23 seems to require that ecological consequences be evaluated, but the implementation guidance in Standard 3009-94 appears to say it is not necessary. If ecological impacts are to be addressed explicitly in the SARs, then these interviewees said that more guidance is needed as to what this means and how to do it. The general opinion of the interviewees appeared to be that the current SAR approaches of protecting human health, providing defense-in-depth, and using extent of a potential release as a measure of adverse ecological impact provided adequate protection of ecological resources. They noted that integration with NEPA assessments, as required in the order and guidance, was often ineffective. According to the interviewees, this is because NEPA documents are often old and out of date (if they

exist at all) and the NEPA language and emphasis are different from that of the SAR, making a consistency comparison difficult. They also said that communication between NEPA and SAR teams is often not very effective.

At the large site, the environmental managers responsible for NEPA, RCRA permitting, and implementation of biota monitoring as required by DOE Orders 5400.1 and 5400.5 felt that the lack of a defensible, comprehensive approach for ecological assessments resulted in, at best, uncertainty as to the adequacy of ecological protection and, at worst, inadequate protection. These managers also felt that the approaches currently being used, mainly expert opinion and limited, project-specific monitoring, often did not provide a defensible approach to support decision making with respect to protecting ecological resources at the ecosystem level.

Environmental managers at all sites were concerned about the narrow focus of most ecological evaluations, e.g., project-specific, media-specific, site-specific, or species-specific. The need for a well-specified, comprehensive ecological assessment approach to guide data collection and support decision making was recognized by environmental managers at all sites. However, to date, efforts to develop such an approach have not come to fruition at any of the sites.

Environmental managers from all sites said that the lack of integration across programs resulted in separate and often duplicative sampling and analysis activities. Environmental managers noted that integration across programs within a facility and with other federal and state agencies that collect environmental data was needed. Managers felt that the lack of integration across programs is at least partially a result of the DOE organizational structure and the resulting funding process. One interviewee gave the example of having to respond to several "masters"—EM, EH, and DP Headquarters managers; field managers; and the DNFSB. This interviewee noted that these different "masters" did not talk to each other and had different agendas and requirements; this often led to confusion, large resource expenditures, and little progress. At both the large and small sites, environmental managers noted that the lack of integration of NEPA, RCRA permitting, and other environmental protection programs with the environmental restoration program resulted in inefficiencies and potential inconsistencies.

At the medium site, which is facing severe environmental budget cuts, it was generally recognized that duplicate sampling and analysis activities in support of the myriad of environmental compliance regulations and DOE orders could not be supported any longer. This site has already begun to drastically reduce its environmental monitoring efforts to be in line with current and future budget cuts while still meeting the current permit requirements of RCRA, CWA, CAA, NEPA, state regulations, and DOE Orders 5400.1 and 5400.5. Having recently completed a major attempt at streamlining its monitoring programs, this site has begun to recognize the risks associated with reducing these monitoring programs without a clear decision-based, integrated rationale to provide a defensible basis for these reductions.

Environmental managers at all sites indicated that NEPA provided an adequate procedural model but often had been poorly implemented, particularly with respect to the assessment of ecosystem impacts and cumulative effects. They indicated that this was largely a result of the lack of a framework to guide these assessments and of the project-specific focus and funding of NEPA impact analyses. They also indicated that the NEPA process was rarely used for comprehensive planning as intended and often was simply viewed as an administrative hurdle that had to be addressed to move forward with a project whose planning was complete. NEPA environmental managers also identified the lack of appropriate ecological baseline data to adequately support some NEPA EAs and EISs, particularly a site-wide EIS, as a serious problem. They indicated that this lack of adequate data was the result of the lack of an appropriate framework to guide data collection, the limitations imposed by project-specific funding, and the time constraints associated with project implementation requirements.

5.2. Interviews with Industry Environmental Managers

The goal of the industry interviews was to learn about industry ecological risk assessment drivers, approaches, costs, and issues to compare with those of DOE and to glean useful information for DOE environmental managers from industry.

Interview questions were in five areas: (1) documenting the background of the respondent and his/ her responsibilities, (2) defining the environmental compliance drivers and the use of assessments, (3) determining if environmental management systems were being used such as ISO 14000, (4) defining the characteristics and effectiveness of environmental management protection and compliance programs, and (5) determining the funding source and costs of environmental programs. The industry interviews also explored the level of integration existing

between various environmental compliance activities, the techniques used to integrate activities, and the motivation for integration efforts. The list of interview questions is in Appendix B.

These interviews were conducted with environmental managers from eight large petroleum, mining, rubber, brewing, aerospace, and computer manufacturing companies. These industries were selected because they were nation-wide, had multiple facilities, and had environmental issues comparable to those of DOE facilities. Telephone interviews with respondents lasted about 1 hour, and written notes were taken of responses. No attempt was made to conduct a statistically valid survey. Thus, the results cannot be viewed as representative of the industries; rather, they are simply the opinions of those individuals interviewed.

The following discussion summarizes the results of the industry interviews relevant to this project. Although not discussed in this paper, these interviews also provided valuable lessons learned in the broader area of environmental management. A complete description of the industry interviews is available in a report titled "Environmental Management Lessons Learned from Interviews with Industry Managers" (Kelly and Vertucci 1996)

One industrial facility has found that ecological benchmark levels are often overly conservative and result in cleanups that are too expensive and do not provide significant risk reduction. Rather than accepting regulatory benchmark levels, this company invested in bioavailability field studies. These studies resulted in much higher cleanup levels, which provided an estimated cost savings of $65 million.

An industry environmental manager stated that, in his experience, the higher the quality of the assessment data, the more focused the remediation objectives and the lower the costs. He stated that quality data come from careful planning.

Industry data collection activities are generally very focused on decisions that need to be made. Decisions are often business related, e.g., to introduce a new product, to acquire a new facility, etc. Decisions are clearly stated and clearly linked to the data collection process.

Several companies indicated that they take a proactive approach to environmental compliance. They anticipate potential problems and take steps to avoid them.

Several companies indicated that top-level managers (the board of directors) are actively involved in environmental compliance and protection issues.

Several large companies with multiple facilities indicated that integration of compliance activities was important. These companies promoted integration through management strategies.

The big issue for several large companies was NRDA liability. The recognition of the value of ecological assessments typically increased dramatically after these companies incurred NRDA lawsuits and extensive remediation costs. For many of these companies, ecological assessments are now a regular part of all business decisions. The environmental managers for these companies noted that conducting CERCLA activities under the cloud of NRDA litigation becomes extremely difficult and is something to avoid if at all possible.

Several companies either have or are in the process of adopting an ISO 14001 Environmental Management Systems (EMS) approach. Reasons include (1) "it just makes good sense," (2) a system is needed to determine what is being done and to measure how well it is being done ("upper management can assume things are getting done when they aren't"), and (3) a management system with clear lines of responsibility and internal and external auditing is needed.

6.0. CONCLUSIONS FROM THE DOCUMENT REVIEW AND INTERVIEWS

The current federal regulatory driver for ecological risk assessment is CERCLA. Many DOE RCRA facilities follow CERCLA risk guidance and are including ecological risk evaluations in corrective action remediation decisions. A potential regulatory driver is the draft HWIR, which uses ecological risk assessment (as well as human health risk assessment) to develop levels for delisting hazardous waste. Another potential driver is NRDA injury assessment. Industry environmental managers facing NRDA lawsuits noted that ecological risk assessments have high priority at their sites. NEPA requires an evaluation of alternative actions; it does not explicitly require risk assessment but does require evaluations of impacts to T&E species, wetlands, and wildlife.

Ecological risk assessments are not formally required by any DOE order or regulation, although draft 10 CFR 834 does require a dose assessment to biota from radiological releases. Many DOE orders require environmental protection, but many of these orders are intentionally open-ended and vague in terms of what is meant by environmental protection. This is particularly true in terms of protecting and assessing impacts to ecological resources. This lack of detailed guidance provides sites with flexibility in implementing the orders, but it also can result in confusion about what is required and disjointed efforts that are activity- and project-focused and do not provide the comprehensive view necessary to defensibly address ecosystem-level concerns. The lack of a comprehensive approach for evaluating impacts to ecological resources was a major concern identified by DOE environmental managers in the interviews. In addition to defensibility and protection issues, disjointed, narrowly focused approaches also can result in costly duplication of efforts and inconsistencies in results.

The analysis of cumulative impacts required by NEPA is extremely difficult, if not impossible, without a comprehensive ecological impact assessment approach. A defensible approach for cumulative impact analysis is needed by DOE (as well as other agencies) because this is an area that opponents of projects are using to, if not stop, at least significantly slow down proposed projects. A recently filed lawsuit against the DOE stated in the Statement of Facts, "The NEPA documents ... do not adequately analyze the cumulative environmental impacts of other past, present, and reasonably foreseeable actions. . . ." In the Request for Relief, the plaintiffs requested that the Court enter the following relief: "Declare that (the agency) has violated the National Environmental Policy Act by failing to adequately evaluate the cumulative environmental impacts of programs and projects. . ." (CIV 96-0508LH 1996).

Ray Clark, a senior policy analyst with the CEQ, notes that

> "experience suggests that perhaps the most ecologically devastating environmental effects may not result from the direct effects of a particular proposal, but from a combination of existing stresses on the environment, coupled with the individually minor effects of multiple actions over time. In fact, some authorities contend that all environmental effects can be seen as cumulative. . ." (Clark 1993).

Clark also notes that "the lack of environmental baseline data and the scale at which most agencies plan makes cumulative effects assessment extraordinarily difficult." He states that "if development is to proceed in a sustainable fashion methods must be established which will permit a look at proposals in the context of space and time that can be the basis for holistic decision making."

The results of this study support the determination that there is a real need for DOE Headquarters to provide high-level guidance as to how to approach integrated, comprehensive ecological impact assessments. A process-oriented integrated, comprehensive ecological impact assessment approach should provide the framework for biota monitoring (Order 5400.1 and 5400.5 and draft 10 CFR 834), NEPA baseline data collection (Orders 5440.1E, 451, 10 CFR 1021), and NEPA cumulative effects analysis. It also should enhance and focus the site-wide conceptual model and guide the identification of assessment and measurement endpoints needed for CERCLA, RCRA, and NRDA ecological risk assessments. Such an approach should also guide, or be linked to, the development of land-use planning-related asset management performance measures (Order 430.1) and provide a basis for the assessment and ranking of ecological hazards and risks in safety analyses. A comprehensive, integrated approach should encompass requirements of more narrowly focused ecological data protection regulations, such as those associated with T&E species, migratory birds, and wetlands.

7.0. REQUIREMENTS FOR AN INTEGRATED, COMPREHENSIVE APPROACH

As stated above, an integrated approach must be multi-objective in the sense that it meets the objectives and decision requirements of multiple environmental assessment and protection activities. Figure 1 shows a simple framework for an integrated approach. At the top, providing integration across all activities, is the site-specific ecological management policy statement. Emanating from this policy statement are activity-specific quantifiable management goals. These management goals may vary depending on the activity; however, there is an opportunity to integrate at this level by identifying common goals. (Figure 1 shows this for four possible activities: ER, land management, NEPA, and safety management.) Performance measures emanate from the management goals. Activities should be integrated at the performance measure level. Data collection activities are driven by the need to assess performance measures to evaluate progress toward achieving the management goals. The data collection activities should also be integrated across activities to ensure consistency and efficiency.

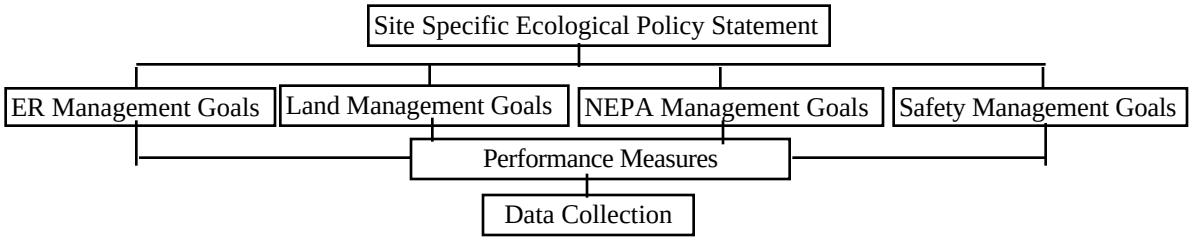

Figure 1. Framework for an Integrated Approach. This framework for an integrated approach provides integration at the policy level and at the performance measures and data collection levels.

The following discussion presents a hypothetical example illustrating the various components of the integrating framework. A site-specific ecological management policy might be the following.

This DOE facility will manage its unimpacted areas

1. to maintain the high-quality plant and animal habitat on the site,
2. to improve the habitat condition of areas in less than excellent condition,
3. to protect the habitat of T&E species,
4. to keep all future uses that are currently viable open for consideration, and
5. to comply with local state and federal environmental and land use regulations.

Examples of specific management goals for the four activities in Fig. 1 associated with ecological policy statement 3 above include

- select remediation alternatives that minimize adverse impacts to the area and quality of the Preeble's meadow jumping mouse habitat (ER Management Goal),
- maintain and improve the current area and quality of the Preeble's meadow jumping mouse habitat (Land Use Management Goal),
- evaluate the impacts of proposed projects on the area and quality of the Preeble's meadow jumping mouse habitat (NEPA Goal), and
- evaluate any adverse impacts of potential accidents to the area and quality of the Preeble's meadow jumping mouse habitat (Safety Management Goal).

Examples of performance measures derived from these management goals include measures of habitat extent and habitat quality. To ensure effective and efficient data collection activities, performance measures should be associated with management decisions, for example, the following.

Evaluate ER alternatives/land use alternatives/project alternatives/safety measures to achieve the stated management goals if one or more of the following occur.

- If the area of the habitat will decrease (modeling may be used to predict impacts)/decreases by 10%
- If the plant species richness will decrease/decreases by 20% from baseline
- If foliar cover will become/becomes 20% or more weeds
- If stem density of shrubs will decrease/decreases by 20%

Integrated data needs for the management decisions presented above include baseline and monitoring data on the area of the habitat, plant species richness, nonnative plant species, and stem density of shrubs. The data collection plans for the baseline and monitoring data are based on the uncertainty specifications, the variability of the data, and the time frame for making decisions. This example illustrates how performance measures and the data collection activities to evaluate those performance measures can be integrated to effectively and efficiently support meaningful DOE performance measure evaluation and defensible decision making across multiple environmental protection and assessment activities.

Routine monitoring data also should support decisions regarding the effectiveness of a facility's habitat management practices related to the habitat in question. For example, a habitat management plan to maintain a high- quality grassland might include a weed management plan, controlled access to workers and recreational users, restricted road construction and maintenance, protection of wildlife populations that graze on the grassland, and implementation of a controlled burn program. Clearly, these habitat management actions must be implemented proactively; implementation cannot wait for the results of monitoring data. Instead, monitoring data are used to assess the combined effectiveness of the habitat management plan in relation to achievement of the specified goals.

One of the keys to developing an integrated approach is the development and maintenance of a fully integrated information management system that includes data storage, retrieval and analysis with Geographic Information System (GIS) capabilities. Such a system is needed to relate the full range of environmental aspects (sources) and effects in the creation of a site-wide conceptual model and to support decision makers and planners. Development of such a system should be coordinated across DOE and with regulator and trustee agencies to ensure that the system is fully accessible to all essential parties both for data retrieval and sharing. The system should include application software to facilitate routine data analysis as well as GIS capabilities that facilitate geographical-based data retrieval. The level of development and complexity of the system should be commensurate with need. There are commercial products available, such as Intergraph or ARC/Info, that could provide the structure for the entire information management system.

A well-integrated information management tool will provide a tool to explore

- topography;
- infrastructure;
- vegetation, habitat, or land cover;
- potential future use designations for planning decisions;
- environmental aspects of concern (potential contaminant sources), including inactive RCRA/CERCLA units, operating facilities, point emission sources, known nonpoint source emissions, etc.;
- site ecological receptors, i.e., measurement and assessment endpoints of concern, with identification of related habitats, exposure, and toxicological information;
- T&E species habitat, wetlands, and sensitive habitats;
- viable transport and/or exposure pathways;
- site geology;
- site demography; and
- site hydrology.

Much of this information is, or should be, available at individual DOE sites as mandated by DOE Order 4320.1B, Site Development Planning. This includes informational data standards and metadata standards. In addition, Executive Order 12906 defines the establishment of a National Spatial Data Infrastructure that should contribute to and coordinate with DOE Environmental Management Data activities.

8.0. LESSONS LEARNED DEVELOPING AN INTEGRATED, COMPREHENSIVE APPROACH

As noted previously, one DOE site currently is developing an integrated approach for ecological monitoring and impact assessment. To develop the approach, environmental managers for all of the relevant environmental programs as well as DOE managers, regulators, and local government representatives convene regularly in facilitated meetings to develop policy statements, management goals, performance measures, and related decisions and to specify thresholds and decision uncertainties.

This is work in progress; hence, no definitive conclusions about its success or failure can be drawn. However, a number of lessons have been learned already that may be of value in considering how to proceed with the task of

developing a comprehensive, integrated approach to ecological risk assessment in support of decisions associated with environmental compliance regulations and DOE orders.

The first lesson learned is that moving from a regulation-by-regulation, order-by-order mind set to a high-level systems mind set is very difficult. In addition to the difficulty of imposing a new way of thinking, change itself is threatening. Change is particularly threatening in an environment of budget cuts and layoffs. This makes it almost impossible to gain the trust of those participating. Participants fear that the end result will eliminate programs and jobs. The process of gaining trust and implementing change is slow. One can expect only evolutionary change, not revolutionary change.

The organizational structure of DOE and the resulting funding structure also make integration very difficult. A classic example is the separation of environmental restoration activities (DOE-EM) from the rest of the environmental, safety, and health programs (DOE-EH).

The ambitious task of looking at each of the existing monitoring programs at a high level and establishing what actually is needed from each program is fraught with difficulties. It requires total commitment from senior management as well as from the individuals who will actually implement the approach.

One of the difficulties is that there are inevitably numerous parallel initiatives in progress. These initiatives are often conflicting and overlapping and cause considerable confusion. Much like any Total Quality Management (TQM) effort, to be successful in changing monitoring programs in any substantial way, one or more senior managers from key positions are needed to keep the efforts alive and make success a key aspect of the performance evaluations of the individuals involved in implementation.

Another difficulty is identifying the appropriate key senior manager(s). It is often difficult to find the ultimate "decision maker" who is not only willing but able to champion change.

It is important for the individuals involved in developing an integrated approach to have clearly defined roles and responsibilities. If the individuals do not have a clear understanding of their authority or the role that they should be playing, then no one takes the responsibility for success seriously.

Developing an integrated approach requires a facilitated, structured process. A structured process is required so that the difficult changes are dictated by process, not by an individual. The structure helps to keep participants on track. The Data Quality Objectives (DQO) process is one example of a facilitated, structured process that could be used to develop a comprehensive, integrated approach (EPA 1994).

It is important that the facilitator of the process does not have a vested interest in the outcome and that the participants are cognizant of this. The facilitator frequently must do more than facilitate. He or she must do much of the work, developing draft policy statements, management goals, decisions, etc.; presenting these to participants for comments and critique; making changes; and repeating the process until an agreed upon approach is developed. It is unrealistic to assume that the environmental managers and stakeholders will have the time to do this work themselves.

Stakeholder participation is essential to develop an approach that will be accepted by EPA, the state, the US Fish and Wildlife Department, DOE, local communities (including Indian tribes), and other interested and affected parties.

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APPENDIX A
DETAILED INTERVIEW RESULTS FROM A DEPARTMENT OF ENERGY FACILITY

1.0. INTRODUCTION

In-depth interviews were conducted in late 1995 and early 1996 with 20 environmental managers and support staff responsible for implementing environmental protection and clean-up orders and regulations at a large DOE facility. The designation "large" refers to the extent of the ecological resources at the facility The high-level goals of these interviews were to explore two questions.

(1) How effective are current environmental protection compliance activities in
   - ensuring the protection of ecological resources associated with DOE DP facilities and
   - providing the necessary information to evaluate impacts to those resources in support of DP decision making?

(2) How efficient are current compliance activities in terms of providing the ecological impact information needed to support current operations and to plan for future activities?

To achieve these goals, we first reviewed the regulations, orders, and standards requiring environmental protection and assessment of environmental impacts. To determine how these requirements were actually being carried out, we interviewed environmental managers responsible for implementing these regulations and orders.

The interview questions were designed to explore the following questions.

- Do compliance activities meet the intent of the associated orders or regulations with respect to the protection of ecological resources? If they do not, what is needed to remedy this problem?
- Can compliance activities be better integrated to provide a more cost-effective approach for protecting ecological resources and supporting the relevant DOE decisions?
- If integration of compliance activities is appropriate, what is an efficient and effective integrating framework?
  - Would the development of a site-wide conceptual model be a useful integrating approach?
- What are the impediments to integrating activities (organizational structures, sources of funding, lack of accepted methodology, etc.)?
- Which (if any) activities add nothing (or very little) to the ecological resource decision-making process?
- Which (if any) add nothing (or very little) to the protection of ecological resources?

2.0. INTERVIEW QUESTIONS

In almost all cases, interviews were with one individual at a time; the interviews were never with more than two individuals. The following questions were asked of each interviewee.

Interviewee's Relationship to Orders/Regulations

1. It is our understanding that these (show list) are the DOE orders and state and federal regulations that your group is responsible for implementing that call for determining potential damage to the environment or evaluating environmental consequences or impacts. What additions or deletions should be made to this list?

2. For each of these orders (rules) or state and federal regulations that you are familiar with, what is done to specifically address ecological impacts as part of the environmental impacts evaluation?

3. When in the life cycle of the facility are these orders (rules) or state and federal regulations applicable (preconceptual design, conceptual design, preliminary design, detailed design construction, operational readiness, facility operation, D&D)?

4. What are the key decisions associated with these orders (rules) or state and federal regulations? (Relate decisions to stages of facility life cycle if possible.)

Related Activities/Communication Between Related Activities

5. How do the DOE orders relate to state and federal requirements?

6. Are there any other groups (used here in the generic sense to represent groups, sections, programs, etc.) performing similar activities or activities where there would be some benefit associated with the exchange of information?

7. What kind of communication, if any, occurs among these groups?

8. What could be done to enhance the information exchange between groups

Additional Documents, Regulatory Interactions, and Costs

9. What, if any, guidance documents or standards are associated with these DOE orders or state and federal regulations?

10. For each order (rule) and state and federal regulation, what reports are generated?

11. What regulator interactions are required? What DOE interactions? What regulatory (DOE) organizations are responsible for enforcement?

12. Is there any estimate of the costs associated with implementing the order (rule), the regulation? What about costs specifically associated with assessing ecological impacts?

13. What interactions with the public are associated with the orders (rules) and regulations?

Interviewee Perceptions and Feedback

14. What do you think about the usefulness/appropriateness of the way that ecological issues are addressed under these orders and/or regulations?

15. Do you think there is a better approach? If so, what would that be?

16. Given the goals of this review project, are there other questions we should be asking? What do you consider to be important issues?

3.0. INTERVIEW RESULTS IN TERMS OF ECOLOGICAL PROTECTION AND IMPACT ASSESSMENT

Table 1 summarizes the results of the interviews in terms of ecological protection and ecological impact assessment, and the discussion provides the details associated with the Table 1 entries.

TABLE 1

INTERVIEW SUMMARY TABLE
(ECOLOGICAL PROTECTION/ECOLOGICAL IMPACT ASSESSMENT)

	Ecological Protection			Ecological Impact Assessment		
Orders & Regulations	**Implicit/ Explicit**	**Ecological Resources**	**Evaluation of Protection**	**Approach**	**Ecological Endpoints**	**Evaluation of Approach**
5400.1 & 5400.5 (834)	Explicit	Biota	Inadequate	Monitoring & Habitat Baseline Data	Elk, fish, honeybees, small mammals, aquatic invertebrates	Inadequate
CAA	Implicit	Not specified	Adequate	Monitoring	Not specified	Uncertain
CWA	Explicit	Aquatic species, wildlife	Adequate	Monitoring	Aquatic invertebrates	Uncertain
RCRA	Implicit	Not specified	Inadequate	Compliance activities Monitoring	Not specified	Inadequate
ER: RCRA/ CERCLA	Explicit	T&E species; resources with ecological, economic, and stakeholder value	Uncertain	EPA framework (ecozone approach)	Under development	Uncertain
NEPA	Explicit	T&E species Wetlands Floodplains	Inadequate	Expert judgment	T&E species Wetlands Floodplains	Inadequate
5480.23 3009-94 5481.1B	Implicit	Not specified	Adequate	Integration with NEPA, extent of contamination	Not specified	Inadequate
5000.3B	Explicit	Not specified	Adequate	Expert judgment	Determined by subject matter experts	Adequate

The following gives the definitions of the terms are used in Table 1.

- **Implicit/Explicit:** Is there explicit mention of protecting ecological resources or are ecological resources protected implicitly by protecting human health, monitoring, or meeting standards?
- **Ecological Resources:** Are ecological resources either explicitly or implicitly identified, e.g., aquatic species, wetlands, threatened and endangered species, biota, etc.?
- **Evaluation of Protection:** Does the interviewee believe that the approach taken (e.g., protecting human health, meeting standards) provides adequate protection of ecological resources?
- **Approach:** How are impacts evaluated (e.g., monitoring, modeling, ecological risk assessment)?
- **Ecological Endpoints:** Are ecological endpoints (e.g., ecosystem sustainability) either explicitly or implicitly identified? Are assessment endpoints (e.g., elk population) and measurement endpoints (e.g., concentrations of contaminants in elk livers) identified?
- **Evaluation of Approach:** Does the interviewee consider the approach taken to be adequate in terms of providing the information needed to support the relevant DOE decisions (e.g., decisions related to adequate protection of ecological resources with respect to current, past or future operations, potential accidents, or land use planning?

3.1. DOE Order 5400.1: General Environmental Protection and DOE Order 5400.5, Radiation Protection of the Public and the Environment

Several groups are responsible for collecting data to meet the monitoring requirements of these orders. The following discussion reflects only the interviews of members of the group responsible for biota monitoring. The air and water quality organizations' monitoring activities are really driven by the CAA and CWA; therefore, the interviews with these two groups are presented under those regulations.

Ecological Protection

Implicit/Explicit: Explicit. Monitoring of biota is required under 5400.1 and 5400.5; however, there are no guidelines for determining what biota to monitor. A recent DOE audit indicated that this facility should be doing more monitoring of biota.

Ecological Resources: Biota. There is no guidance on what resources are to be monitored; therefore, biota monitoring has evolved somewhat serendipitously. Data have been collected on honeybees, elk, small mammals, and foodstuffs. Aquatic invertebrate data at outfalls are also collected as part the requirements of the CWA. Aquatic invertebrate data also have been collected in one canyon in response to spills. The foodstuffs data have been collected in the context of human health concerns rather than ecological concerns.

Evaluation of Protection: Inadequate. These are monitoring and reporting orders. There is no guidance on what to monitor or how to relate monitoring data to protection of ecosystems.

Ecological Impact Assessment

Approach: Monitoring and habitat baseline data. The monitoring activities determine the presence or absence of contamination in the monitored species. The habitat baseline data provide information on what areas have suitable habitat for various species and to some extent what species have actually been observed in these areas. The habitat baseline data are primarily qualitative.

Ecological Endpoints: Elk, fish, honeybees, small mammals, and aquatic invertebrate diversity data at outfalls (as required by the CWA). Measurement endpoints include presence and absence of radiological contaminants in fish and mammals and diversity of aquatic invertebrates. However, these measurement endpoints are not tied back to assessment or ecological endpoints. There is no framework for decision making based on the results of the monitoring data.

Evaluation of Approach: Inadequate. There is no guidance as to what biota data should be collected or how the data are to be used. There is essentially an infinite amount of data that one could collect. Without some framework to guide data collection and assessment, it is a waste of resources to sample more biota. Also, historically, there has not been enough funding for monitoring activities. What funding there has been has been to support particular projects and has been too narrowly focused to support ecological risk assessments.

3.2. Clean Air Act (CAA)

This discussion summarizes interviews with individuals from the group responsible for the implementation of the CAA.

Ecological Protection

Implicit/Explicit: Implicit. Monitoring of air contamination is focused on radiological contamination and potential human health impacts. Protection of ecological resources (in terms of radiological effects) is implicitly implied or assumed by protecting human health.

Ecological Resources: Not specified. Specific ecological resources are not implicitly or explicitly identified with respect to releases of radionuclides to the air. Monitoring activities are focused on potential release pathways to human populations. The CAA requires meeting a human health inhalation dose limit of 10 mrem/yr at the site boundary.

Evaluation of Protection: Adequate (Conservative). In terms of radiological impacts, the very stringent requirements for human health are adequately protective of ecological resources. Acceptable

doses from releases are in the "noise" of naturally occurring background doses. The facility does not have air pollution issues for non-radiological contaminants.

Ecological Impact Assessment

Approach: Primarily stack point-source monitoring, watching for regulatory compliance. This group deals with the CAA and the Air Quality Control Regulations, which have some fairly straightforward aspects. The state now has primacy and is in the process of taking over the nonradiation part of the CAA, although this is on hold right now because of lack of state personnel. This group calculates the radiological doses to humans from all pathways, air, water, and soil or food ingestion for the environmental surveillance report (ESR), but ecological impacts are not evaluated.

Ecological Endpoints: No ecological endpoints have been identified.

Evaluation of Approach: Uncertain - Not clear what information is required for decisions related to protection of ecological resources.

3.3.Clean Water Act (CWA)

This discussion summarizes interviews with individuals from the group responsible for the implementation of the CWA.

Ecological Protection

Implicit/Explicit: Explicit. There are quality levels, discharge limits and overall water controls to be met in order to comply with this Act. Some of these levels pertain to livestock and wildlife watering. Levels are generally set through negotiations with the State. The Safe Drinking Water Act, Water Quality Act, and state Water Quality Compliance requirements further outline resources to be targeted and standards to be followed.

Ecological Resources: Ecological resources include aquatic species, outfall biota, and wildlife.

Evaluation of Protection: Adequate. This group does not evaluate ecological impacts, but the many different regulatory requirements are presumed to provide adequate ecological protection in terms of adverse ecological impacts from exposures to surface and ground water discharges. The group monitors to ensure that the regulatory requirements are met.

Ecological Impact Assessment

Approach: Monitoring. Provide support for some ecological activities through funding for monitoring to determine the effects of outfalls on aquatic invertebrates. The group performs a lot of cooperative monitoring and sampling with stakeholders, focusing on radiation in sediments and ground water.

Ecological Endpoints: Biodiversity of aquatic invertebrates and community tolerance quotient.

Evaluation of Approach: Uncertain. No real agreement by people (regulators, ecologists, stakeholders) regarding what is the proper ecological assessment approach. No explicit link of invertebrate monitoring results to compliance decisions. Without a conceptual model or concurrence by decision makers of decision endpoints for ecological assessment, the process can be driven by a regulator's or investigator's own interests.

3.4.Resource Conservation and Recovery Act (RCRA) (waste disposal)

This discussion summarizes interviews with an individual from the group responsible for the implementation of the RCRA waste disposal requirements.

Ecological Protection

Implicit/ Explicit: Implicit. The charter of RCRA is to protect human health and the environment through waste disposal standards. The intent of the regulation is to protect the environment by minimizing the release of contamination to the environment from the disposal of waste.

Ecological Resources: Not specified. The regulation focuses on groundwater sources, air emissions, waste management.

Evaluation of Protection: Inadequate. The focus is on waste disposal; even if in full compliance, there could be long-term significant detrimental effects on the environment from many small (permitted) releases. This is because low-level releases can bioaccumulate in the long term. Prevention is easiest and cheapest way to provide protection. Once contaminants are in the environment it is very expensive to characterize and clean up.

Ecological Impact Assessment

Approach: The focus is on working with programs to make sure they are in compliance with RCRA waste disposal requirements. The group is also involved with negotiations with the State in terms of compliance requirements. The group monitors ground water and other media as appropriate.

Ecological Endpoints: Not specified. Again the focus is on physical media criteria—waste disposal activities, groundwater sources, air emissions.

Evaluation of Approach: Inadequate. A better understanding of cumulative impacts of waste disposal activities on ecological resources is needed. A framework for ecological assessments to help with negotiations with the State could be useful.

3.5.Resource Conservation and Recovery Act (RCRA)—Corrective Action, and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

RCRA corrective action is implemented by the Environmental Restoration (ER) Project. Ecological assessments for the ER Project are conducted by a different group than the group responsible for biota data collection and NEPA. It should be noted that this facility is not a CERCLA site, but the RCRA ER Project complies with the DOE guidance to conduct the ER Project in a manner consistent with CERCLA.

Ecological Protection

Implicit/Explicit: Explicit. CERCLA specifically calls for an ecological risk assessment. EPA regulators require that ecological impacts are evaluated in the RCRA cleanup process.

Ecological Resources: The specification of ecological resources to be evaluated in the ER Project is still under development. The eco-resources will be based on those identified in EPA's Framework for Ecological Risk Assessment, including Threatened and Endangered (T&E) species and those with ecological and economic value.

Evaluation of Protection: Uncertain. This facility has been attempting to use a screening process for ecological risk assessments, but that process is not based on realistic spatial scales for ecological risks and is generally overly conservative. The ER Project now recognizes the need to base ecological risk evaluations on ecologically relevant spatial scales and is now in the process of making the transition. This approach should provide adequate protection of ecological resources for the purposes of cleanup decisions, the uncertainty enters in that the approach is still under development and there seem to be problems getting regulator approval and acceptance by the ER Project's managers.

Ecological Impact Assessment

Approach: Ecological risk assessment based on the EPA's framework document and using an appropriate ecological spatial scale ("ecozones").

Ecological Endpoints: Under development . In the previous screening approach, this facility used guilds to identify its endpoints utilizing animal size and food source. The new system considers biochemical and physiological, individual, population, community, and ecosystem endpoints.

Evaluation of Approach: Uncertain. The ER ecological team is currently in the process of revamping the ecological risk assessment process through the creation of ecozones. Ecozones are realistic and useful, however, a comprehensive database for biota is needed to implement this approach and is not in place.

3.6.National Environmental Policy Act (NEPA)

The biota monitoring group is also responsible for completing NEPA checklists and conducting some environmental assessments**.** DOE is responsible for EISs and the site-wide EIS (SWEIS)**.** The interviewees for this

regulation and associated orders represented the biota monitoring group and the DOE SWEIS personnel and DOE's SWEIS contractor.

Ecological Protection

Implicit/ Explicit: Explicit. The intent of the word "environment" in NEPA is much broader than ecological resources, it includes all factors affecting the "human environment," including archaeological, noise, and visual impacts. NEPA is not explicit about what ecological resources are to be included in assessments other than floodplains, threatened and endangered species and critical habitats, and wetlands.

Ecological Resources: Ecological resources include wetlands (most wetland activities are done under 10 CFR 1021), floodplains, and threatened and endangered species and their habitat. At this facility floodplain issues are usually safety issues rather than protecting floodplains. The goal of NEPA ecological activities is to preserve the quality of ecosystems, their trophic level and species diversity. It is up to the appropriate experts to determine what ecological resources will be evaluated.

Evaluation of Protection: Inadequate. There is no guidance as to what to evaluate in terms of ecological impacts. NEPA is not very effective from an ecological perspective because we don't know how to evaluate adverse impacts to animals and plants - i.e. toxicity data is lacking for many species. NEPA should evaluate adverse impacts to ecological resources, but better guidance is needed to make this a reality. NEPA has no real clout because NEPA merely presents possible adverse impacts from potential actions, the final decision on what alternative is selected does not have to minimize these adverse impacts.

Ecological Impact Assessment

Approach: Expert judgment. NEPA activities include determining if a categorical exclusion is appropriate or an Environmental Assessment (EA) or Environmental Impact Statement (EIS) is needed. A checklist is filled out to determine if an EA or EIS is required. The EA describes the project and the impacts that might occur. If there is a significant environmental consequence (this decision is made by DOE), then an Environmental Impact Statement (EIS) is required. The EIS looks at environmental impacts. EPA, the State, and affected tribes review all EAs and EISs, but the final decision is the DOE's. NEPA evaluates operational and accidental impacts. NEPA evaluates impacts from the worst case accident scenarios.

Ecological Endpoints: Endpoints are usually left to expert opinion. Traditionally NEPA considers impacts to T&E species and habitat, wetlands, and floodplains.

Evaluation of Approach: Inadequate. NEPA should be used as a planning tool early in the process, but this is not usually the case. NEPA is not implemented early enough, major planning decisions are often already made. NEPA is more of a procedural process than a planning process. Historically, the coordination between NEPA activities and safety analysis reports (SAR) has been poor. There are currently attempts to improve this coordination, but there is still room for improvement.

3.7.DOE 5480.23: Nuclear Safety and Analysis Reports, DOE STD 3009-94, Preparation Guide for U.S. Department of Energy Nonreactor Safety Analysis Reports, DOE 5481.1B, Safety Analysis and Review System

The facility's risk management and assessment groups implement these orders. Managers and staff from both groups were interviewed.

Ecological Protection

Implicit/ Explicit: Implicit. DOE 5480.23 and the related Orders and Standards call for environmental protection and evaluating environmental consequences. Although there is no explicit mention of ecological resources, it is assumed that ecological resources are a component of the environment to be protected and evaluated.

Ecological Resources: Not specified.

Evaluation of Protection: Adequate. The SAR focuses on protecting human health, but the safety basis provided by the SAR provides an adequate safety basis for protecting ecological resources. It is

unlikely that focusing on human health requirements results in missing accidents that could cause significant damage to ecological resources. Potential accidents that are associated with this site's facilities do not result in widespread release of contaminants. Contamination from potential accidents is usually very localized, therefore, ecological damage is not a major concern.

Ecological Impact Assessment

Approach: Integration with NEPA/Extent of Contamination. There is no SAR guidance for evaluating ecological consequences or for developing ecosystem indicators. There is a requirement to make sure the SAR is consistent with the NEPA hazards analysis and that SAR accidents are within the NEPA accident envelope. Ranking of environmental consequences in hazard analyses has been based on the potential extent of contamination. The assumption is that it takes a very large release to the environment to have a significant impact on ecological resources.

Ecological Endpoints : Not specified.

Evaluation of Approach: Inadequate. Integration of NEPA environmental assessment and the SAR is usually not effective. Comparing SAR analyses to NEPA analyses to see if the SAR is in the accident envelope is difficult because the two approaches are so different. If environmental consequences are to be considered in the SAR, better guidance is needed. It is probably not appropriate to have ecological consequence evaluations as part of the SAR. The current approach of using extent of contamination as a criterion for ecological impacts is likely to be adequate. DOE guidance needs to clarify what is meant by environmental protection and evaluating environmental consequences in the context of the SAR.

3.8.DOE 5000.3B Occurrence Reporting and Processing of Operations Information

This discussion summarizes the interview with an individual from the group responsible for occurrence investigations and reporting.

Ecological Protection

Implicit/Explicit: Explicit. The facility's guidance for occurrence reporting specifically identifies ecological impacts as a factor to be considered in determining the significance of an occurrence. However, there is no specific guidance on what constitutes a significant ecological impact. In practice, ES&H experts are advised of the occurrence, and they make a call as to the ecological significance (significance determines what gets reported and to whom).

Ecological Resources: None identified; rely on ES&H expert opinion.

Evaluation of Protection: Adequate. At this facility very few, if any, occurrences have a significant ecological impact. The main concern at this facility is the potential for radiation exposure to workers and the public.

Ecological Impact Assessment

Approach: Expert judgment. ES&H experts determine ecological significance of occurrence.

Ecological Endpoints: No specific endpoints are specified. However, experts use endpoints used in NEPA evaluations and other programs (such as impacts to critical habitat).

Evaluation of Approach: Adequate. This group brings the appropriate experts to the table to determine whether or not there has been a significant occurrence. There are no specific ecological significance criteria, however, incidents are scrutinized very thoroughly and reporting levels dictated by DOE orders are followed. The problem is not that significant incidents are missed, but that extensive efforts are spent on minor occurrences.

4.0.INTERVIEW RESULTS IN TERMS OF KEY DECISIONS, MAJOR ACTIVITIES AND PRODUCTS, AND EFFICIENCY ISSUES

Table 2 summarizes the results of the interviews in terms of key decisions, the major activities and products, and the efficiency issues identified by the groups responsible for implementing the orders and regulations. The following discussion provides a detailed description of the information summarized in Table 2.

TABLE 2

INTERVIEW SUMMARY TABLE (ENVIRONMENTAL COMPLIANCE EFFICIENCY)

Orders & Regulations	Key Decisions	Activities/Products	Efficiency Issues
5400.1 & 5400.5 (834)	No key decisions—surveillance program	Monitoring/environmental monitoring plan, Environmental Surveillance Report (ESR)	Time, money, manpower, know-how, planning, coordination, no eco-approach
CAA	Compliance	Monitoring and related reports	Coordination, communication, political pressures
CWA	Compliance	Monitoring and related reports, legal challenges to state requirements	Communication, education, conflicting regulations
RCRA	Focus on negotiations rather than decisions	Corrective actions, permitting; monitoring/compliance activities	Communication, coordination, consistency, no defensible eco-approach
RCRA/ CERCLA	Cleanup-related decisions	Workplans, phase reports (risk assessments), remediation plans	No agreed-upon ecological risk approach
NEPA	EA or EIS determination	Checklists, EAs, support for EISs.	Lack of early implementation, lack of integration with SARs, projects, and DOE, inadequate data
5480.23 3009-94 5481.1B	Is facility safe? SSCs TSRs	HA, PSAR, SAR, FSAR	No ecological guidelines/methods, conflicting guidance, NEPA integration
5000.3B	Occurrence significance	Occurrence reports	No ecological guidelines

4.1.5400.1: General Environmental Protection and 5400.5 Radiation Protection of the Public and the Environment

Key Decisions: This is a surveillance program and is not tied to decision making. Decisions as to what to monitor are made according to what project or program has the money to support monitoring. There is no clear link between monitoring results and decision-making policy.

Activities/Products: The major activities are biological surveys and monitoring. Activities also include data collection activities in canyons and outfall monitoring in support of the CWA. Products include the Environmental Monitoring Plan and compilation of the Environmental Surveillance Report (ESR).

Efficiency Issues:

- The obstacles to efficient operations are time, money, manpower, planning, and know-how.
- The environmental assessments activities at this facility have had little attention and very little funding. Because of the lack of funding, the group only does what it can get done with limited project-specific resources.
- There is no ecological methodology that provides guidance for what biota to sample and how to use sampling results. A DOE audit determined that more biota monitoring is needed, but the question of what to monitor was not addressed.
- A site-wide database, which contains all relevant data, is needed to reduce redundant efforts and improve efficiency.
- There is a need for better coordination with the RCRA environmental restoration (ER) project and the group responsible for ecological risk assessments.
- There also needs to be better education of the facility's staff about environmental issues.
- Guidance documents are useful as long as they don't become too rigid. Lack of flexibility usually leads to inefficiencies and ineffectiveness.
- Activities are often driven by program needs and concerns about public perceptions - e.g. don't cause delays, don't cost too much, get in and out quickly, etc.

4.2.Clean Air Act (CAA)

Key Decisions: Decisions are compliance decisions, e.g., is a facility in or out of compliance?

Activities/Products: Compliance monitoring activities and related reports. This organization's focus is on radiation. The group does most of the dose assessments for potential human exposures from all media. The monitoring data for the CAA also go into the ESR required by DOE Order 5400.1.

Efficiency Issues:

- A process is needed for getting data into and out of the ER central environmental database; however, it's not part of the institutional plan to develop a coordinated database. There is no attempt to ensure data comparability between programs. All data are based on best available technology, it is not clear that this is a cost-effective approach.
- There is little or no sharing of information between programs. For example, the ER project is not using this groups air monitoring data, thereby, losing what could have been a significant cost savings. The ER Project does not use this group's personnel to monitor air during cleanups, this presents confusion as to responsibilities and liabilities.
- This group is often required to expand monitoring stations based solely on political reasons without any clear technical benefit . Pressures come from stakeholders. This expanded monitoring is costly.
- Risk is not driving standards. Standards are arbitrary and very conservative. The 10 mrem/yr standard costs tens of millions of dollars as compared to a more realistic, risk-based standard.

4.3.Clean Water Act (CWA)

Key Decisions: Decisions are compliance decisions, for example, determining if a facility is out of compliance and, if it is, what measures should be taken bring it into compliance.

Activities/Products: Activities and products include compliance monitoring activities for CWA permit and NPDES, monthly reports to EPA and to the outfall owners, and relevant chapters in the ESR. Activities and products can also include extensive reports and legal briefs to support legal challenges to state requirements when these requirements are overly conservative.

Efficiency Issues:

- Communication with staff of the operating groups and the training of these staff about the CWA requirements are not always effective, nevertheless, communication and education are high priority activities. To improve communication between the CWA specialists and the facility's groups, and thereby improve the operating group's understanding of the CWA, ES&H staff are assigned to operating groups. Their mission is to provide timely assistance to the operating groups and to train the group staff in the area of CWA compliance.
- The biggest efficiency issue specifically associated with ecological assessments is that there is no real agreement by responsible parties as to what is the proper ecological assessment approach. For every approach there are opposing viewpoints. Since there is no agreed upon approach, activities can be heavily influenced by different political agendas.
- Another efficiency issue is that some regulations are in conflict with each other. The CWA necessitates the reduction or elimination of the discharge of waste water, however, this results in the destruction of wetland habitat that has grown up around these discharges.

4.4.Resource Conservation and Recovery Act (RCRA) (waste disposal)

Key Decisions: This organization is more involved in negotiations than decisions. Waste management practices are based on human health threats rather than ecological threats.

Activities/Products: Activities include monitoring, corrective actions, and permitting. This organization performs compliance activities for both RCRA and TSCA, so there aren't duplicative efforts and nothing falls through the cracks. The group produces biennial reports for regulatory drivers and annual treatability studies.

Efficiency Issues:

- The current structure of ES&H activities (separate groups for biota, water, air, and RCRA located at different facilities) interferes with effective communication and integration of activities. These separate groups were once one group, and communication was much better. Internal negotiations with programs are often more difficult than negotiations with state.
- DP, EM, EH, field offices, and DNFSB support different initiatives. Having many different masters leads to confusion about the line of command and results in inefficiencies. These organizations do not communicate effectively. A classic example of this is that RCRA corrective action activities are separate from other RCRA activities—this leads to consistency problems, redundancies, and inefficiencies.
- Although there are RCRA standards, much is negotiable. However, there is no strong technical basis for negotiations. A defensible approach for ecological assessments would support negotiations.

4.5.Resource Conservation and Recovery Act (RCRA)—Corrective Action and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

Key Decisions: Ecological risk assessments will support cleanup decisions, e.g., what is the ecological risk associated with identified alternatives? The risk manager makes the decision as to the best alternative.

Activities/Products: The ecological risk assessment team must work with the ER teams to determine the appropriate sampling and analysis activities for ecological assessments. The group provides input to field unit RFI reports.

Efficiency Issues:

- Conservative benchmark ecological screening levels were not useful to the ER Project because they did not provide an effective screen to separate problems from non-problems. It is anticipated that the new ecological-zone approach will be more useful because it considers the appropriate spatial and temporal scales. However to date, the team has not been able to develop an overall ecological risk framework for the ER Project.
- There is very little management support for the necessary surveillance and monitoring activities to support ecological risk assessments.
- Organizations with related or associated functions have lost effective communication and have experienced political fragmentation.

4.6.National Environmental Policy Act (NEPA)

Key Decisions: Decisions are supposed to be planning decisions about the environmental impacts of siting a new facility, initiating a new project, or making significant modifications to an existing facility or project. The environmental impacts of these activities are assessed and the first decision is whether any further studies are required. Further studies might include an environmental assessment (EA) or an Environmental Impact Statement (EIS). DOE makes this decision.

Activities/Products: Products resulting from this facility's NEPA activities include a DOE environmental checklist, draft EAs, and input to EISs. The facility does not actually conduct EISs, DOE hires contractors to perform this activity. However, the facility does provide information to support the EISs.

Efficiency Issues:

- NEPA is suppose to be a planning tool, but it is usually not implemented early enough for planning. The result is that the NEPA process becomes a procedural process rather than a planning process.
- The NEPA process must use existing data and usually the existing data are not adequate for determining ecological impacts. The lack of appropriate existing data also results in the failure of NEPA to be an effective planning tool.
- There is no integrated project tracking and NEPA studies are not well integrated with SARs.
- There is also a need for better integration with DOE.
- NEPA activities often provide no environmental benefit because too much time and money are spent on minor problems. There is a need for a graded approach.

4.7.DOE 5480.23: Nuclear Safety and Analysis Reports, DOE STD 3009-94, Preparation Guide for U.S. Department of Energy Nonreactor Safety Analysis Reports, DOE 5481.1B, Safety Analysis and Review System

Key Decisions: The key decision is determining if the facility can operate safely. This decision translates into determining if the facility can operate—a critical decision. Related decisions include determining what are safety-class and safety-significant SSCs and what TSRs are needed.

Activities/Products: The major activities include performing hazard and accident analyses, determining safety-class and safety-significant SSCs, and documenting the results in the SAR.

Efficiency Issues:

1. Efficiency issues with respect to ecological protection and ecological consequence analysis include the following.
   - The lack of guidelines or methods for evaluating consequences to ecological resources. If ecological concerns are to be included in the SAR, then more guidance is needed as to what this means and how it is done.
   - There is confusion as to whether or not ecological concerns are to be addressed explicitly in the SAR. DOE 5480.23 seems to require evaluating ecological consequences, but 3009-94 appears to say it is not necessary.
   - NEPA integration is ineffective. NEPA documents are often old and out of date (if they exist at all). The NEPA language and emphasis is different, making a consistency comparison between SAR and NEPA analyses difficult. Cross talk between NEPA and SAR teams is not effective, however, it is the experience of one interviewee that this cross talk has been effective for NRC safety analyses.
2. General efficiency issues include the following.
   - Communication: The SAR is often viewed as a *"bean or necessary evil"* to be completed in order to move forward with a project, versus a useful document for facility safety decision making. The useful information is buried in a voluminous document and rarely made accessible to the appropriate facility managers.
   - Integration: Activities (groups/programs) are segmented around orders, and there is no integration; e.g.. one group has responsibility for 6430.1A, another has responsibility for 5480.23, another implements RCRA, and yet another does RCRA corrective actions.
   - *Ad Hoc* Process: The content of a SAR depends on the orientation of DOE personnel (one person wants one thing; another wants something different). There is no consistent strategy or specified procedure for SAR reviews. This results in a lack of consistency and quality reviews. There is no consistency in composition of SAR teams or SAR review teams, the right people may or may not be on the teams. The DOE SAR process does not have the formal structure of the NRC safety process. Everything is negotiable, DOE is the owner and the regulator. DOE decisions are not adjudicated as are NRC decisions. DOE does not need the same rigor as the NRC because facilities aren't as uniform or dangerous, but DOE does need more structure.

4.8.DOE 5003.B Occurrence Reporting and Processing of Operations Information

Key Decisions: The occurrence reporting group is concerned with determining if an incident is significant, thereby requiring reporting. If the incident is significant, the group must decide who to notify (DOE, EPA, State, all three, etc.) and what mitigation measures to take.

Activities/Products: This organization brings together subject matter experts to determine if there is a problem and the extent of the problem. The group notifies the appropriate federal, state, and local contacts regarding any releases and generates occurrence, notification, and final reports.

Efficiency Issues: These issues relate only to assessing ecological impacts as part of occurrence reporting.

- Ecological impact assessment is really an orphan as there are no criteria or standards for gauging the severity of impacts as there are in the area of public or worker impacts.
- The emphasis is almost entirely on radiological releases; therefore, ecological impacts are not the drivers. Public and worker exposures are the drivers.

APPENDIX B
INDUSTRY INTERVIEW QUESTIONS

A. Respondent Background

1. Job Title:
2. Current major responsibilities:
3. Past major responsibilities:
4. Education/training background:
   (BS, MS, Ph.D., Military, Other)
5. What type of industry?
6. Can we use your company name?
7. Describe the nature of your experience dealing with:
   Characterize as None = 0 ---> Extensive = 10
   - NEPA
   - CERCLA
   - NRDA
   - RCRA
     - Closures
     - Operations
     - RFI/CMS
   - CWA
   - CAA
   - ESA
   - OSHA
   - TOSCA
   - FIFRA
   - FDCA
   - OTHER

B. Compare industry and DOE's environmental compliance drivers and assessments.

1. What are your drivers for environmental compliance, environmental protection, and environmental safety?
   Which are you responsible for ?
   Which require *environmental assessments*?
2. What are your primary environmental compliance/protection and safety issues?
3. Which are you responsible for?
4. Which require *environmental assessments*?
5. What is included in these *environmental assessments*? Are *risk assessments* used?
   (Natural History or T&E Survey, Habitat Evaluation, Biomonitoring, Media Concentrations, Fate and Transport, Toxicity Identification/Reduction Evaluation, Water, Sediment, Soil Toxicity Studies, Product Registration Testing, Natural Resources Damage Assessments, etc.)
6. What decisions are supported with *environmental assessments* and related data collection activities (clean-up goals, compliance documentation, process improvements, design, planning, litigation support)?
7. How are the results of these *environmental assessments* used in decision making?
8. What process do you go through to establish data needs for *environmental assessments*?
   (Are DQOs defined?)
   Do you involve regulators and other stakeholders?
   If yes, how and when (during plan development or during review and approval)?
9. Are *ecological impact assessments* conducted?
10. If so, by what methods (expert judgment, injury under NRDA, ERAs following EPA framework)?
    How are ecological impacts quantified (qualitative or quantitative risk assessment, comparison to standards)?
11. How are results of *ecological impact assessments* used in decision making?
12. What are the issues associated with the use of *ecological risk assessments*?
    (Guidance, Benchmarks, Methods, Data Collection, Uncertainty)
13. If ecological risk assessments are not currently being used in decision making, do you anticipate ERAs will be required/useful in the future?

If so, why and how?

14. Do subcontractors or in-house experts conduct environmental assessments?
    What is the role of each?

C. ISO 14000 (EMS)

1. Have you or any of your peers evaluated the ISO 14000 approach to Environmental Management Systems (EMS)?
   If so, what are your impressions?
2. Have you or your peers implemented an EMS approach (even if not part of 14000)?
   Why choose an EMS?
   Why choose not to have an EMS?
3. If you or your peers have or are implementing an ISO 14000, what are the advantages?
   What are the disadvantages for ISO 14000?

D. Compare industry environmental compliance/environmental protection with DOE's.

1. Does your/your client's company have a clear environmental policy?
   How would you describe the policy; a global statement or is it specific, detailed, and substantial?
2. At what level of management are environmental issues addressed?
3. Does upper management have an effective mechanism to evaluate environmental/protection/ compliance/safety programs? Yes No
   If so, what is it?
4. What organizational structures are used to carry out your environmental compliance and protection programs?
   Are responsibilities divided across specific media or regulatory programs?
   If not, how are they divided?
5. How would you describe the relative importance of regulatory compliance versus the company environmental policy with regard to motivating the environmental programs your company has in place?
6. Are environmental programs integrated across facilities or does each facility have its own programs (structures)?
   If there is integration, how is this accomplished and what does it entail?
   What motivated the integration efforts?
7. Is there an attempt to integrate activities of the programs (structures) within facilities?
   If so, what was the motivation for integration?
   What are the integrating activities?
8. How are negotiations with federal and state regulators handled?
   Who has responsibility?
   What problems, if any, are associated with these negotiations?
   Can you identify some particularly notable successes and briefly describe them?
   Are negotiations with state regulators handled differently?
9. What are the consequences of non-compliance?
   To the company (liability, corporate image)?
   To the responsible individual(s)?
10. What metrics are used to evaluate continuous improvement in the environmental arena (e.g., number of violations, levels of fines assessed on an annual basis, number of public or worker complaints, awards for achievement, positive or negative news stories)?

E. Funding basis and cost issues.

1. What per cent of overall budget is spent on environmental compliance/ environmental safety?
2. What environmental programs are viewed as cost-effective versus not cost-effective?
   Why?
3. What are the implications of environmental costs for company operations?
4. How are funding levels for the various environmental compliance/protection programs determined?

Definition of Terms Used in Questions:

Environmental Assessments:
Generic activity where impacts to the environment are assessed.

Ecological Assessments:
Impacts to ecological resources assessed.

Ecological Risk Assessments:
Likelihood of a stressor causing an adverse ecological effect.